

### **REMARKS**

Claims 1-9 and 11-80 are currently pending. No claims have been amended or cancelled in this response.

Applicant wishes to thank the Examiner for his consideration during the telephone conference on June 27, 2006. During the telephone conference, the Examiner and applicant's representatives discussed the invention and the cited reference McDonald.

#### **§ 101 Rejections**

The Examiner has rejected claims 1-9 and 11-63 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. The Examiner's basis for rejecting these claims is, in part, because they "do not constitute a manipulation of tangible physical objects and result in the object having a different physical structure or attribute." (Examiner's Action, April 19, 2006, p. 2.) In support, the Examiner cited *Diamond v. Diehr* for the proposition that "a process is statutory if it requires physical acts to be performed outside the computer independent of and following the steps to be performed by a programmed computer." (Examiner's Action, April 19, 2006, p. 2.)

Applicant respectfully disagrees with the Examiner's reading of *Diamond v. Diehr*. The Federal Circuit Court of Appeal has clearly stated that "after *Diehr* and *Alappat*, the mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers and storing numbers, in and of itself, would not render it non-statutory . . . " *State Street Bank & Trust Co. v. Signature Financial Group Inc.*, 149 F.3d 1368, 47 USPQ2d 1596 (Fed. Cir. 1998). In addition, the Federal Circuit has recently noted that a "structural inquiry is unnecessary" when determining whether a process claim is eligible for patent protection." *AT&T Corp. v. Excel Communications, Inc.*, 172 F.3d 1352, 50 USPQ2d 1447 (Fed. Cir. 1999). The test for patent eligibility should be whether the process produces "a useful, concrete and tangible result." *Street Bank & Trust Co.*, 149

*F.3d at 1373*. The Court held that "the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, because it produces a useful, concrete and tangible result." *Street Bank & Trust Co.*, 149, *F.3d at 1373*.

Here, applicant's technique involves similar transformation of data as in *Street Bank & Trust Co.* Deriving a final share price from discrete dollar amounts is similar in scope as "calculating a score for the defect type ... based on a relationship between the extent of the defect type and the maximum extent of the defect type." Further, the calculated score for the defect type is "useful" and has a "tangible result" because the score represents the effect to the current condition of the pipe for having defects of the particular defect type. Therefore, applicant respectfully submits that the claimed invention is directed to statutory subject matter because it produces a "useful, concrete and tangible result." (See *also*, "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility," Official Gazette Notices, November 22, 2005).

#### § 102 Rejections

The Examiner has rejected claims 1-80 under 35 U.S.C. 102(b) as being anticipated by McDonald. Applicant respectfully traverses these rejections and submits that McDonald cannot support a Section 102(b) rejection of these claims because McDonald fails to teach or suggest several features of the pending claims.

#### A. Applicant's Technique

Applicant's technique is directed to calculating a defect type score that represents the current condition of a piece of pipe (e.g., 100 feet of underground sewage pipe) having defects of the defect type. The defect type score is based on not only the category, form, and severity of the defect type but also the extent of the defects. According to applicant's technique, the pipe is first inspected for defects by using, for example, visual inspection, CCTV inspection, etc. Quantitative and qualitative measures can be taken during such

inspections. For example, an inspector can assess the severity of a defect, and measure the length of a defect in the pipe.

Then, the inspector provides a defect type and an extent for each of the defects discovered during the inspection. The defect type has a category, a form, and a severity. The defect type can be continuous or point. An example of a continuous defect is a longitudinal (i.e., the form) fracture (i.e., the category) less than 10mm wide (i.e., the severity). An extent for a continuous defect type is the length of the continuous defect. For example, the longitudinal fracture less than 10mm wide may extend for 30 feet in the inspected 100-foot pipe. An example of a point defect type is a circumferential (i.e., form) hairline (i.e., severity) crack (i.e., category). An extent for a point defect type is the number of sections in the pipe that contain defects of the point defect type. For example, if the 100-foot pipe is divided into 20 sections of 5-foot portions, and 10 portions have circumferential hairline cracks, then the extent for the defect type is 10 in the 100-foot pipe.

A defect type can also be categorized as either a structural defect or a maintenance defect. As their names suggest, a structural defect relates to a problem in the structure of the pipe, and a maintenance defect relates to a problem in maintenance of the pipe. For example, a longitudinal fracture crack is a structural defect, whereas 20% blocking settled debris is a maintenance defect. When calculating an overall score for the pipe, each type of defects can be categorized separately or combined to derive the overall score.

For each defect type, a maintenance administrator can define a defect type score range between a base defect type score and a maximum defect type score. The maintenance administrator can assign the base and maximum defect type scores based on various considerations, such as the impact of the defect type, difficulty of repairing the defects of the defect type, etc. The base defect type score represents the score of a single defect of that defect type that has the minimum possible extent. For example, a longitudinal fracture less than 10mm wide can be defined to be at least 1 foot long, and its base defect type score is 10. A fracture that is less than 1 foot long can be defined to be a

different defect type (e.g., an irregular hole). The maximum defect type score represents the score for defects of that defect type that have the maximum extent. For example, a longitudinal fracture less than 10mm wide can have a maximum defect type score of 80 when the defect of this defect type extends along the entire length of the pipe (i.e., 100 feet).

A defect type score that represents the current condition of the pipe having defects of the defect type can then be calculated based on a relationship between the extent measured during inspection and the maximum extent of the pipe. For example, the defect type score can be a score that is calculated by linear interpolation as showing in the following formula:

$$DS_{C_t} = BDS_t + \left\{ (MDS_t - BDS_t) \left( \frac{DL_t}{SPL} \right) \right\}$$

where  $DS_{C_t}$  is the defect type score for the continuous defect type  $t$  of the pipe,  $BDS_t$  is the base defect type score for the defect type  $t$ ,  $MDS_t$  is the maximum defect type score for the defect type  $t$ ,  $DL_t$  is the extent of the continuous defect type  $t$ , and  $SPL$  is the maximum extent for the defect type  $t$ . Thus, for a longitudinal fracture less than 10mm wide that is 30 feet long in the 100-foot pipe, the defect type score can be calculated as following:

$$DS_C = 10 + \left\{ (80 - 10) \left( \frac{30}{100} \right) \right\} = 31$$

After all defect type scores are calculated for various types of defects discovered in the pipe segment, a grade for the segment can be calculated based on a combination of the defect type scores. The grade, also known as an "internal grade," represents an overall internal condition of a pipe by combining the individual defect type scores. In one

example, the grading is calculated by weighting each defect type score geometrically less than the next higher defect type score as showing in the following formula:

$$SDG_g = \sum_{i=1}^m \frac{DS_i}{(100)^{i-1}}$$

where  $SDG_g$  represents the structural defect grade based on a geometric weighting,  $DS_i$  is the defect type score for a continuous or point defect of the defect type  $t$  ( $DS_{C_i}$  or  $DS_{P_i}$ ) in the structural defect group, and  $m$  represents all the structural defect types ordered from highest to lowest defect type score.

For example, if the defect type scores for a pipe are 80, 70, and 30 for three defect types (e.g., longitudinal fracture less than 10mm wide, root blockage, and debris blockage), and the weight of each defect type score is only one-hundredth of the weight of the next higher defect type score, then the overall score can be calculated as following:

$$SDG_g = \frac{80}{100^0} + \frac{70}{100^1} + \frac{30}{100^2} = 80.703$$

In another example, a root-mean-square approach can be used to combine the individual defect type scores as following:

$$SDG = \sqrt{\frac{maxDS^2 + \left[ \frac{1}{n} \sum_{i=1}^n DS_i \right]^2}{2}}$$

where  $SDG$  represents a structural defect grade,  $DS_i$  is the defect type score for a continuous or point defect type  $t$  within the structural defect group,  $maxDS$  represents the highest defect type score within  $DS_i$ , and  $n$  represents the number of all the structural

defect types except the one with the highest defect type score. In the example above, the overall score can be calculated as following:

$$SDG = \sqrt{\frac{80^2 + \left[ \frac{80 + 70 + 30}{3} \right]^2}{2}} = 70.711$$

In another example, the overall score can be calculated based on a highest defect type score of the pipe combined with a secondary score derived from remaining defect type scores of the pipe.

As described above, applicant's technique derives a defect type score for the pipe by taking into account both the severity and the extent of each defect so that defects having different extent can be differentiated. Another feature of applicant's technique is the consideration of each and every defect discovered in the pipe when calculating the overall score. As a result, the overall score can more accurately reflect the current condition of the pipe than conventional techniques, such as McDonald's technique discussed below.

#### B. McDonald's Technique

McDonald describes guidelines focusing on the impact, condition assessments, and rehabilitation of large diameter sewers. The guidelines provide an approach for assessing the impact of pipe failure, coding defects, and assigning priorities for rehabilitation. (McDonald, Abstract.) McDonald aims to provide unified definitions of terminology and a consistent defect coding system such that information can be shared between utilities across Canada. (McDonald, Abstract.)

When inspecting pipes, McDonald discloses using techniques such as closed-circuit television (CCTV), combined sonar/CCTV, person-entry, and stationary camera. (McDonald, 363.) For example, an inspector can use CCTV for a preliminary inspection. If

a CCTV inspection has flagged a particular pipe segment, further investigation may be required to assess the exact condition of the damage. (McDonald, 364.) For example, if the CCTV inspection reveals an open joint, ground penetrating radar may be used to determine whether voids exist behind the pipe walls. (McDonald, 364.)

McDonald further discloses grouping sewer defects into service defects and structural defects. Each defect has a unique name and definition. (McDonald, 364.) For example, service defects can include infiltration (I), root intrusion (R), etc., and structural defects can include fractures (F), cracks (C), etc. Each defect is coded based on clear definitions of each type of defect and its severity. For example, infiltration is defined as "the ingress of groundwater through a defect or defective joints or connections," and the defect codes can include the following (McDonald, 364.):

Defect Type	Definition
Infiltration Light (IIL)	seeping or dripping
Infiltration Moderate (IIM)	running or trickling
Infiltration Severe (IIS)	gushing or spurting

After the inspectors code the defects using the defined defect codes, weights can then be assigned to individual defect codes. (McDonald, 364, Table 2.) For example, infiltration defects can be assigned weights as following:

Defect Type	Weight
Infiltration Light (IIL)	2
Infiltration Moderate (IIM)	5
Infiltration Severe (IIS)	10

Then, an analysis can be carried out to determine service and structural condition ratings based on the inspection data. (McDonald, 364.) The service and structural condition ratings are determined based on the peak scores of defects in the pipe segment (i.e., the highest defect weight). (McDonald, 364.) For example, a peak score within a

range can be assigned a particular condition rating as described in Tables 6 and 7 of McDonald (reproduced below):

Table 6

Peak Score Threshold	Structural Condition Rating
0	2
1 - 4	5
5 - 9	10
10 - 14	3
15 - 19	4
20	5

Table 7

Peak Score Threshold	Service Condition Rating
0	0
1 - 2	1
3 - 4	2
5 - 6	3
7 - 8	4
9 - 10	5

Portions of the inspection data of the sample pipe segment from Table 5 of McDonald are reproduced in the following table

Field Name	Entry Example
Pipe ID	S-1450
Structural Defect Codes	FM, JOL
Peak Score	20
Total Score	23
Service Defect Codes	DEL, EL
Peak Score	5
Total Score	7



According to McDonald, the analysis of the above inspection data can be carried out as following:

I. Determining Weight of each Structural defect

According to Table 2 in McDonald, the code "FM" corresponds to multiple fractures and has an assigned weight of 20. The code "JOL" corresponds to joint opening less than 10mm and has an assigned weight of 3.

II. Determining Peak and Total Scores

Thus, the peak score for the structural defects is 20, and the total score is 23.

III. Assigning Structural Condition Rating Based on Peak Scores

According to Table 6 of McDonald, a peak score of 20 for structural defects carries a structural conditioning rating of 5. Thus, the structural conditioning rating for Pipe S-1450 is 5.

IV. Determining Weight of Each Maintenance Defect

According to Table 2 in McDonald, the code "DEL" corresponds to debris less than 10% flow restriction and has an assigned weight of 5. The code "EL" corresponds to encrustation less than 10% flow restriction and has an assigned weight of 2.

V. Determining Peak and Total Scores

Thus, the peak score for the maintenance defects is 5, and the total score is 7.

VI. Assigning Maintenance Condition Rating Based on Peak Scores

According to Table 7 of McDonald, a peak score of 5 for maintenance defects carries a maintenance conditioning rating of 3. Thus, the maintenance conditioning rating for Pipe S-1450 is 3.

McDonald further discloses that based on these structural and maintenance conditioning ratings, a rehabilitation action plan can be established for the inspected pipes. For example, a condition rating of 5 implies that failure is imminent, and the pipe should be rehabilitated immediately. (McDonald, 366, Table 8). Thus, in the example of Pipe S-1450 above, the Pipe S-1450 should be rehabilitated immediately because its structural condition rating is 5.

One feature of McDonald's technique is its use of only the peak scores when assigning maintenance condition rating for the pipe. As a consequence, the most severe defect in a pipe would determine its currently condition rating irrespective of how many other smaller defects exist in the pipe. Thus, McDonald's conditioning ratings may not accurately reflect, on the whole, the current condition of the pipe.

C. Argument

McDonald does not teach or suggest "providing a defect type score range ... and a maximum extent that is specific to the defect type," and "calculating a score for the defect type ... based on a relationship between the extent of the defect type and the maximum possible extent of the defect type," as recited in claims 1-9, 11-21, and 41-49. Instead, McDonald teaches assigning a single score to each defect based on category, form, and severity of a defect type irrespective of the extent of the defect and deriving a total score by simply summing all the individual scores as illustrated in the table below showing the defect type scores for Pipe S-1450 described above (McDonald's defect type codes are used for illustration purposes).

Table A

McDonald's Technique			Applicant's Technique			
Defect Type	Code	Weight (/Score)	Base Score	Maximum Score	Extent*	Calculated Score
Multiple Fractures	FM	20	1	20	30	6.7
Joint Opening: <10mm	JOL	3	1	10	70	5.8
Debris less than 10%	DEL	5	1	10	10	1.9
Encrustation less than 10% flow restriction	EL	2	1	10	20	2.8

\*A maximum extent of 100 is used here for illustration purposes.

As can be seen from the table above, under McDonald's teachings, defects of the same defect types would have the same score and thus are not distinguished even though the defects have different extents. For example, two pipe segments with the same FLL code would have the same score of 5 even though one fracture in one segment might be ten times as long as the other fractures in the other segment.

In addition, according to McDonald, a total score of a defect type is a sum of all the individual scores, which may not adequately reflect current conditions of the pipe. For example, 6 FLL defects would have a total score of 30 even though each defect is only 1 foot long, but a single FLL defect that is 50 feet long would only have a score of 5. Thus, McDonald neither teaches nor suggests providing a defect type score range and calculating a defect type score based on a relationship between an extent of the defect type and a maximum extent of the defect type as recited by claims 1-9, 11-21 and 41-49.

McDonald does not teach or suggest deriving a grade for the segment "based on a root-mean-square combination of a highest defect type score of the defect types and an average defect type score of the remaining defect types," "based on a geometrically smaller weight being used from the highest defect type score to the lowest defect type score of the pipe," or "based on a highest defect type score of the pipe combined with a

secondary score derived from remaining defect type scores of the pipe," as recited in claims 22-40 and 50-63. In the present Office Action, the Examiner cited "Pooling scarce sewer condition data from various municipalities across Canada will enable the development and verification of statistical models for assessing sewer deterioration and predicting its remaining service life" in McDonald as teaching the various methods of deriving the grade. However, McDonald neither teaches nor suggests applying any statistical techniques to derive pipe grading based on pipe defect type scores, as recited in the pending claims. Instead, McDonald simply states that some kind of statistical models can be used to assess sewer deterioration across municipalities in Canada and does not provide any teachings or suggestions of how those models may work, what calculations they may perform, and what results may be obtained.

In fact, applying McDonald's technique for deriving pipe grades may reach different or even opposite conclusions than applying applicant's technique because McDonald's technique does not consider all the defects of the pipe. For example, the following table compares the results of applying McDonald's and applicant's technique for calculating the overall score and pipe grades for Pipe S-1450 described above. Defect type scores from Table A above are used for illustration purposes.

Table B

	McDonald's Technique				Applicant's Technique			
	Score	Grade	Implication	Recommended Action	Score*	Grade**	Implication	Recommended Action
Structural	20	5	Failed or Imminent Failure	Rehabilitation Priority - Immediate	6.5	2	In fair condition, minimal structural risk	Rehabilitation Priority - Low to Medium
Service	5	3	In poor condition	Rehabilitation Priority - Low to Medium	2.6	2	In fair condition, minimal structural risk	Rehabilitation Priority - Low to Medium

\*Root-mean-square is used here to calculate the score according to applicant's technique for illustration purposes.

\*\*McDonald's Tables 6 and 7 are used to determine pipe grades.

As can be seen from the table above, McDonald over exaggerates the current structural and service condition of the pipe by only considering the peak scores of defects discovered in the pipe. Thus, McDonald neither explicitly nor inherently suggests grading pipes as recited by claims 22-40 and 50-63.

Based upon the above amendments and remarks, applicant respectfully requests reconsideration of this application and its early allowance. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned at (206) 359-8548.

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Respectfully submitted,

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